Natural Resources Management Plan

Sequoia and Kings Canyon

SEQUOIA AND KINGS CANYON NATIONAL PARKS

January 1987 Revision

U.S. Department of the Interior National Park Service

NATURAL RESOURCES MANAGEMENT PLAN

SEQUOIA AND KINGS CANYON NATIONAL PARKS

JANUARY 1987 REVISION

Prepared by

Sequoia and Kings Canyon National Parks
National Park Service
Department of the Interior

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SUMMARY

Natural Resources Management Plan
Sequoia and Kings Canyon National Parks

January 1987 Revision

INTRODUCTION

This Natural Resources Management Plan (NRMP) is a revision of the original November 1976 NRMP and subsequent revisions of June 1981, November 1982, December 1983, April 1984, January 1985, and January 1986. As in the 1976 NRMP, it combines research, management and monitoring activities into projects designed to perpetuate these Parks' ecosystems. It deals with broad resource topics such as vegetation, fish, wildlife, fire ecology, air/water quality, impact of human use, and contains numerous minor modifications and additions.

An Environmental Assessment (EA) accompanied the 1976 NRMP, and it continues to serve as an important reference source for this revised NRMP. Also, a Management Program (MP) was prepared as a separate addendum to the NRMP and EA. Under separate cover, a revised MP was prepared in 1981, 1982, 1983, 1984, 1985, and 1986. Copies of these internal working documents are available for reference from the Superintendent of Sequoia and Kings Canyon National Parks.

This January 1987, revision of the NRMP, which includes the revised MP, presents current programs for these two Parks.

PROPOSED ACTIONS

1. Establish a Geographic Base Information System;

2. maintain native plant species composition; control exotic infestation and disease where feasible;

3. integrate practices of prescribed fire, suppression, and of allowing naturally occurring fire;

4. restore sequoia groves to a condition where they can operate essentially unimpaired by human interference;

5. reduce bear/human conflicts to the lowest attainable level; control plague in developed areas; and control feral pigs, beavers, and other non native (exotic) fauna;

6. continue fish stocking at 1974 levels and monitor fisheries;

7. restore meadows damaged by human activity; regulate grazing;

8. ration backcountry and cave use and;

9. monitor air and water quality.

In addition, research will be conducted on related resource areas, such as vegetation and wildlife, fire ecology, air and water quality, and human use of the backcountry.

ENVIRONMENTAL IMPACTS OF PROPOSED ACTIONS

It was determined through public and National Park Service review of the 1976 NRMP, EA, and MP, that proposed actions lacked potential to cause significant environmental impacts on the human environment. Following Council of Environmental Quality's (CEQ) regulations, a Negative Declaration was prepared and signed on November 17, 1976. Proposed actions in the 1981, 1982, 1983, 1984, 1985, 1986, and the current revision represent minor modifications to the 1976 Plan.

Proposed actions in this revision continue to focus on the restoration of natural conditions and ecological relationships allowing natural processes to operate, and the prevention of environmental deterioration from human activities. Management actions may entail short-term strategies--emplacements, such as deer exclosures, and manipulation, such as relocation and/or

destruction of problem bears. Human use may be regulated, e.g., in some meadow areas, caves, and when prescribed fires are occurring, but rehabilitative measures will contribute to enhancement of visitor experience in the long run. While research into historical ecosystem structure and function will guide the definition of restoration objectives, no specific historical ecosystem structure will be maintained, except around the Grant and Sherman trees. The emphasis of natural resources management is on maintaining natural ecosystem function and processes.

In addition to provisions of the National Environmental Policy Act, ongoing projects and those proposed here comply with the National Historic Preservation Act, the Clean Air Act as amended in 1977, and the Endangered Species Act. Therefore, no further consultation of environmental impacts is necessary prior to carrying out proposed projects. They will begin when funds become available.

Superintendent, Sequoia and Kings Canyon — Date 2/2/87

Regional Director, Western Region — Date 10/20/87

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THE PLAN

INTRODUCTION

The Environmental Assessment (EA) which accompanied the 1976 Natural Resources Management Plan (NRMP) for Sequoia and Kings Canyon National Parks provides valuable background information for this revised NRMP. Readers unfamiliar with the natural resources of these Parks are especially referred to the EA's "Description of the Environment" section, which includes summary descriptions of geology, water, climate, ecosystems, wildlife, archaeology, history, land classification, human use and development, and surrounding land use patterns.

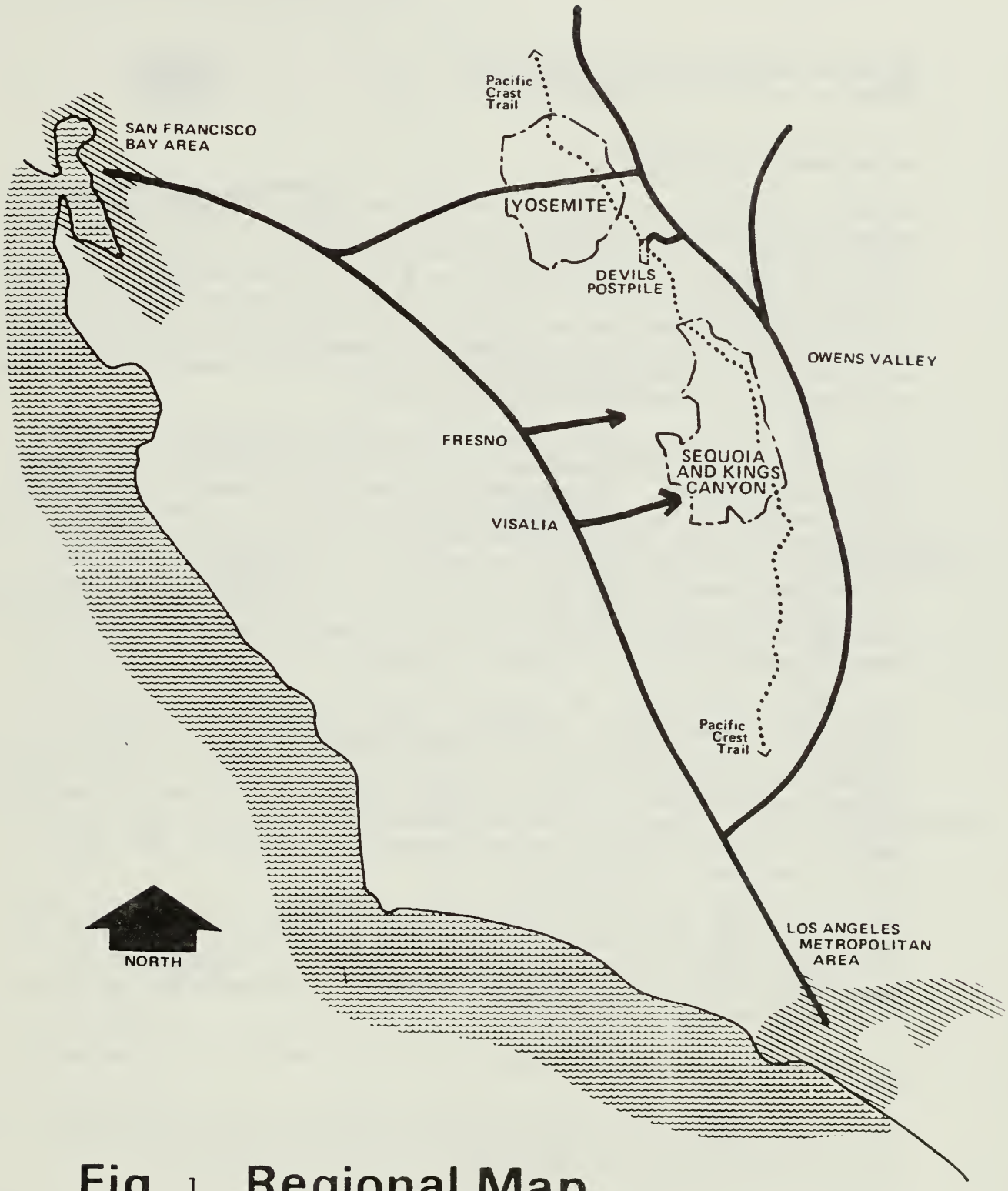


Fig 1. Regional Map

December 1983

MANAGEMENT OBJECTIVES

Natural resources in Sequoia and Kings Canyon National Parks constitute extensive and superlative examples of the biota and physiography of the central and southern Sierra Nevada. Historic uses and management practices have altered some natural ecological relationships and processes, and growing demand for increased recreational use of the area further threatens the preservation of the natural condition. However, present management strategies will focus on conserving these diverse natural resources for the enjoyment of succeeding generations.

This revised Natural Resources Management Plan seeks to allow natural ecological processes to dictate the character of these Parks' ecosystems. It provides for active management programs where necessary to counteract significantly unnatural influences of management and use of these Parks. The plan consists of research to understand the ecological relationships involved, active management programs to correct or mitigate these unnatural influences as they are identified, and resource surveillance, to monitor influences of man on the environment and the effectiveness of natural resources management programs.

This Plan is designed to fulfill applicable Congressional mandates for these Parks. Authority and guidance for various aspects of the plan are found primarily in Management Policies of the National Park Service, enabling legislation for these Parks, various environmental legislation, and Title 36, Code of Federal Regulations. Plan actions are consistent with objectives presented in the Statement for Management for Sequoia and Kings Canyon National Parks.

The following resource management objectives, contained in the Statement for Management, lead to the desired conditions of a park environment where natural processes will be allowed to operate to the fullest extent possible. They provide direction for projects within the Plan.

The overall goal of the natural resource management program is to:

Perpetuate the natural ecosystems of these Parks so they may operate essentially unimpaired by human interference.

Management objectives toward this goal are to:

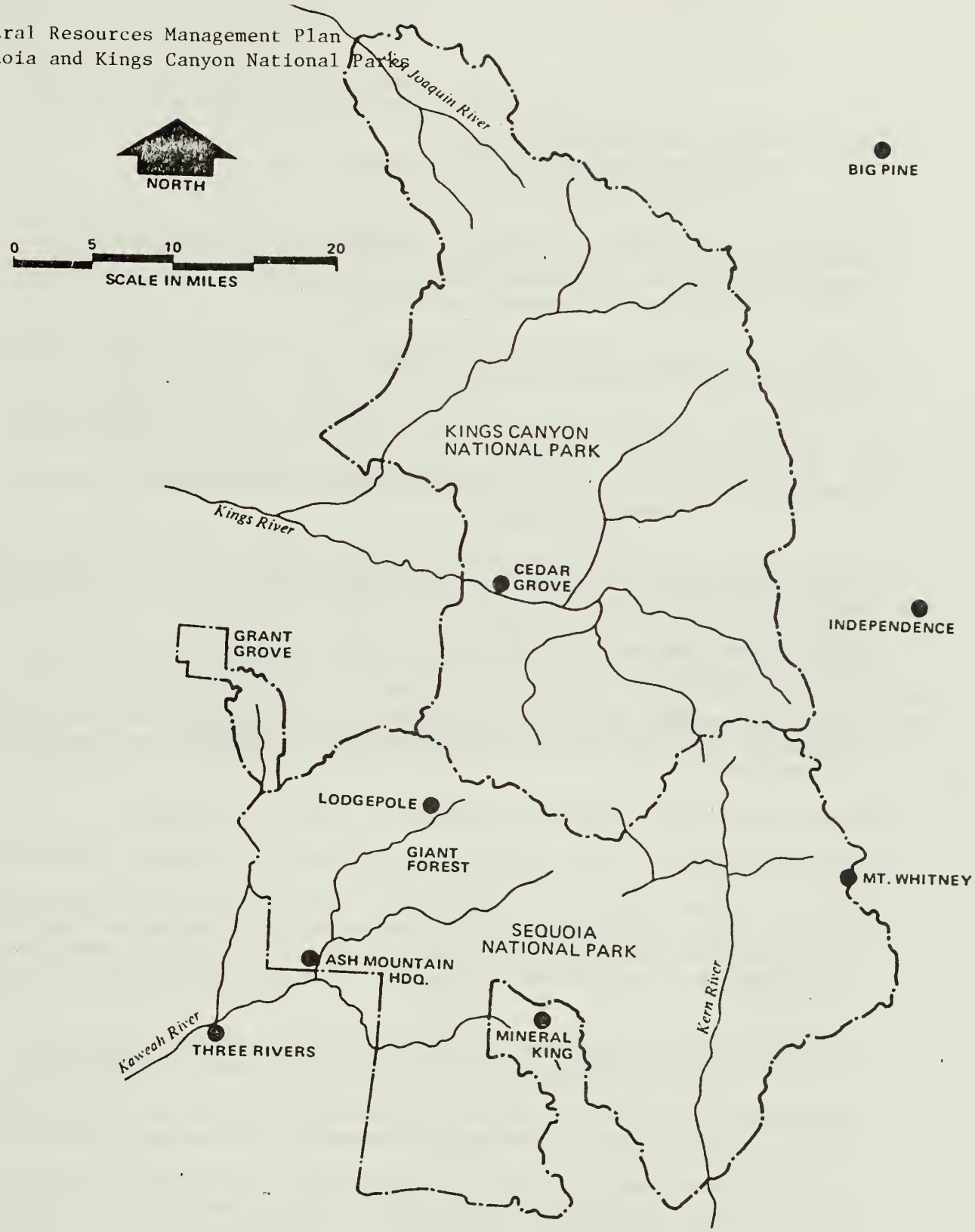


Fig 2. Sequoia and Kings Canyon

--Encourage and support an active research program designed to provide natural resources management with assistance in all aspects of planning, development, implementing, and monitoring natural resources management programs.

--Maintain natural wildlife populations in a natural environment while protecting visitors from harm.

--Give special consideration to protection of rare, threatened, or endangered plant and/or animal species found in these Parks.

--Restore unnaturally altered ecosystems so that natural processes can be allowed to operate.

--Allow naturally occurring fires to play their natural role to the fullest possible extent, with particular attention given to sequoia groves.

--Preserve and maintain sequoia groves to perpetuate the prime scenic resource.

--Limit helicopter use in the backcountry to the minimum amount necessary that still allows management to achieve the purpose of the area.

--Understand major natural processes in park ecosystems.

--Monitor impacts of air and water pollution on natural resources.

--Assist in the regulatory process for the reduction of unnatural air pollution levels to a point where natural resources can be viewed unimpaired by visitors to the greatest extent possible and damage to the natural resources is held to the lowest level possible.

--Provide quality opportunities for visitor understanding, compatible use, and enjoyment of these Parks' natural resources.

--Cooperate with other agencies and outside interests in development of major natural resources management plans and programs.

--Limit National Park Service and concession development to that necessary and appropriate for public use and enjoyment of these Parks, and eliminate or relocate facilities that intrude on or degrade primary natural resources, especially sequoia groves.

--Eliminate all types of park use that significantly interfere with the preservation of natural ecosystems.

ONGOING AND PROPOSED MANAGEMENT ACTIONS

Natural resources management actions now underway, and those proposed follow:

I. Vegetation Management

A Vegetation Management Plan for developed areas will be implemented in 1987. It provides greater detail on managing vegetation in developed areas.

A. Reestablish and maintain native and threatened or endangered plant species composition:

1. Threatened and Endangered Plants

A comprehensive field survey of sensitive plant species was completed in these Parks in 1981 (Norris and Brennan, 1981) and updated information on sensitive plant species in these Parks was published in 1984 (Norris, 1984). Six species are known to occur in these Parks that are candidate species for threatened and endangered status. None of these species has yet been officially classified by Congress as threatened or endangered.

Table 1.

Plant Species, Within These Parks, That Are Candidate Species for Threatened or Endangered Status By The U.S. Fish and Wildlife Service (Notice of Review, Federal Register, Part 2, September, 1985).

Species Name and Author	Elevation Range (from Munz)	Vegetation Type (from Munz)
Alpine/Subalpine Upper Mixed Conifer		
1. *Astragalus ravenii* Barneby	apx. 11,250 ft	Open stony slopes, alpine fell fields
2. *Lupinus culbertsonii* Greene ssp. *culbertsonii*	8,500 to 9,200 ft	Lodgepole pine forests
3. *Oreonana purpurascens* Shevock and Constance	8,260 to 9,200 ft	Sandy to gravelly soils, red fir, lodgepole and mixed
Sequoia Mixed-Conifer		
1. *Erigeron aequifolius* Hall	5,000 to 7,000 ft	Dry ridges, yellow pine forests, red fir forests, rock outcrops
Chaparral/Oak Woodland		
1. *Eriogonum nudum* Dougl. ex Benth. var. *murinum* Reveal	1,650 to 4,000 ft	Rocky outcrops often on marble
2. *Mimulus norrisii* Heckard and Shevock	2,100 to 4,000 ft	Marble outcrops

Seven species of plants not listed as candidate species, but requiring NPS protection under NPS Management policies due to unique occurrences of extremes in distribution within these Parks' boundaries are listed below:

a. Draba cruciata var. integrifolia - Distribution/numbers not clear.

b. Erythronium grandiflorum ssp. pusaterii - Northernmost of four populations.

c. Hackelia sharsmithii - Distribution/numbers not clear.

d. Ribes tularense - All but two of the eight known populations are in Sequoia National Park.

e. Streptanthus fenestratus - Found only in the Middle and South Forks of the Kings River.

f. Pityopus californicus - Two southernmost populations in Grant Grove area.

g. Notholaena jonesii - Two northernmost populations west of the Sierra Crest are in Sequoia National Park.

2. Exotic Plants

The introduction of domestic cattle and sheep by European man brought a variety of mediterranean annuals and other exotics which have since become the dominant understory vegetation in the chaparral/oak-woodland zone. Most widespread are filaree (Erodium spp.), wild oats (Avena fatua), soft chess (Bromus mollis), and bur clover (Medicago hispida). These species are well adapted to the chaparral/oak-woodland zone and cover virtually all of the area. Studies will be conducted to determine the feasibility of controlling these species and reintroduction of native grasses that were abundant before the arrival of European man.

Scotch thistle (Onopordum acanthium), which probably entered these Parks in park stock feed, is also exotic. Because of its spiny characteristics and large size, it can become a serious physical barrier. When concentrated, it can exclude wildlife from using an area or grazing. Concern was expressed in 1972 by the Tulare County Department of Agriculture about the potential of the plant to spread to rangeland adjacent to these Parks. A cooperative effort was started in 1973 with the Tulare County Department of Agriculture to control the plant by digging it up. Scotch thistle will continue to be removed with assistance from the Tulare County Department of Agriculture. Evaluation will continue to be made as to the potential for future spread.

Other exotics, such as foxglove (Digitalis purpurea) and common mullein (Verbascum thaspus), have more recently become established as weeds throughout the area. These exotics will be monitored to determine their impact on native vegetation.

B. Manage incidence of native insect infestations and disease infections only in developed areas and where they reach epidemic levels elsewhere, as policy provides:

1. Bark Beetle Management

Native bark beetles (Dendroctonus spp.) successfully attack stressed pines. In developed areas, human

impact, along with fungi, such as Fomes annosus, dwarf mistletoes, and overstocking have predisposed trees to attack. Detection, removal, and/or chemical treatment of trees infested with insect pests such as mountain pine beetle (D. ponderosae), western pine beetle (D. brevicomis) red turpentine beetle (D. valens) and Ips (Ips spp.) will be conducted.

The only areas subject to this control contain developments (approximately 1,241 acres). The purpose of this management program is to reduce overall stand mortality, thus reducing potential hazards and providing a more aesthetically pleasing environment. Detection and control work is done in spring and fall as needed. Tree removal follows guidelines described under hazard tree abatement. Environmental Protection Agency approved pesticides are applied by trained personnel only.

2. Dwarf Mistletoe

Dwarf mistletoes (Arceuthobium spp.) have infected trees, especially in the developed areas of Cedar Grove. Dwarf mistletoes are parasites which weaken, deform, and kill pine and fir trees. Fire suppression in Cedar Grove in recent years has probably increased the dwarf mistletoe infection well above normal levels by reducing natural pruning and promoting abnormally dense stands of pine and fir. Direct control by pruning infected limbs and removing entire trees to reduce the intensity of the disease and to prevent its spread to adjacent forest stands will be conducted in the developed areas of Cedar Grove.

3. Fomes Annosus

Fomes annosus is an important pathogen of coniferous trees. It affects many trees, particularly in Giant Forest, Dorst Campground, Clover Creek (under construction), Grant Grove, and Cedar Grove developed areas and is a potential source of hazard trees in these areas. Infection centers expand by root contact.

Trees will be removed from Fomes annosus infection centers and the stumps treated with borax. Stand thinning and burning out stumps by prescribed fire will also be used.

C. Control exotic insect and diseases if feasible:

1. Gypsy Moth

Gypsy moth (Lymantria dispar) is an exotic that defoliates both hardwoods and conifers. A gypsy moth detection program is underway in developed areas sponsored by the Fresno and Tulare County Agricultural Commissioners.

2. White Pine Blister Rust

White pine blister rust (Cronartium ribicola) was first detected in these Parks in 1968. A 21,000-acre designated control unit of sequoia groves was established, and infection centers were sanitized by pruning all sugar pine branches within 20 feet of the ground in the immediate vicinity of the center from 1968 to 1977. A biological evaluation conducted by the U.S.F.S. in 1978 indicated that blister rust is permanently established in Sierran forests. It is of limited threat to sugar pine, and U.S.F.S. recommended that the sanitation of infection centers be discontinued. Consequently, no blister rust control program is proposed. Known blister rust infection centers will be monitored and feasibility of using prescribed fire to control blister rust will be determined.

D. Continue a program of hazard tree abatement within roadsides and developed areas:

1. Hazard Tree Removal

About 5,400 live and dead trees have been removed in developed sites and along road sides from 1970 through 1986. These trees die or become structurally unsound as a result of native fungi, insects, mechanical injury, flood, lightning, wind storms, frost damage, and old age. These dead or weakened trees are a serious hazard to people and property in developed areas.

Tree failures causing six injuries, and about $314,000 in property damage have occurred from 1970 through 1986.

The objective of the hazard tree removal program is to establish and maintain a balance which abates tree hazards in areas of high use without unduly manipulating the natural environment. Once the backlog of hazard trees is removed from campgrounds and other developments, about 300 - 400 hazard trees will be removed annually. This maintenance level of control will provide for safety without unnecessary environmental impact.

The following procedures will be used:

a. A standard rating system to assign priority removal values to tree and limb hazards is applied to all developed areas and along major roads. Priority assignments are reviewed within each developed area every three years, except in areas of year-round occupancy, which are reviewed annually.

b. Hazard tree removal is done in each area according to priority value following the guidelines listed below:

    1) All trees are removed in a manner which minimizes damage to remaining vegetation.

    2) All logs from felled trees are removed to their natural breaks so that no visible saw cuts remain. Sections that are left must be laid on the ground and not hung up on rocks or other trees.

    3) All stumps are flush cut. Stumps in campgrounds and high use areas are cut so that no portion is above ground level. Stumps along roadsides are cut so that no portion is more than three inches above the ground.

    4) All cut stump surfaces from living trees are treated with borax, which prevents innoculation by Fomes annosus.

    5) All limbs are lopped and either scattered or mechanically chipped. Chipped material is spread over denuded sites within developed areas.

c. Accurate maps and records will be maintained of all survey and removal work. In addition, investigation of causes and results of all tree failures will be conducted.

Hazard tree removal will be accomplished primarily by Park Forestry personnel. Timber will also be felled and removed by a private contractor to expedite removal of the high hazard backlog trees. Removed hazard trees will be sold as excess property to the highest bidder or as firewood by permit.

E. Artifically revegetate construction sites and heavily-impacted developed areas where human impact impedes natural regenerative processes:

1. Plant Propagation and Revegetation Program

In natural areas, processes such as fire, insects, disease and weather influence death and regrowth of trees and shrubs. In developed areas, because of heavy human use and development, natural replacement of woody vegetation is nearly impossible because of disturbance. A propagation/revegetation program is needed to revegetate sites subject to construction activities, public use, and hazard tree removal, where human impact impedes natural regenerative processes. The revegetation program will ensure that the attrition from hazard tree removal combined with lack of natural replacement will not lead to denuded, unattractive developed areas.

Studies for approximately 900 acres of developed areas will be conducted to determine as natural as possible vegetation mosaic patterns, given present and future conditions of use. Based on results of these studies, a revegetation program will be conducted by transplanting desirable native species from nearby areas. Nursery construction, which began in 1984, will be completed in 1987 to provide a source of native species for revegetation projects. Prior to any construction project, a plan for revegetating and landscaping will be made. The plan will be carried out after construction is completed.

F. Remove Unnaturally Dense Vegetation:

1. Vista Clearing

Because of fire suppression and regeneration of road cuttings, unnatural plant succession along roadways has blocked many scenic vistas. The objective of vista clearing along roadways is to maintain and/or improve scenic vistas. This is expected to improve visitor enjoyment and awareness of park resources. Vista clearing along roadways will be accomplished following standards for hazard tree removal.

2. Stand Thinning

Because of a reduced fire frequency resulting from fire suppression, there are unnaturally dense aggregations of conifers within some developed areas. This overstocking results in competition which weakens these trees, predisposing them to successful bark beetle attack. Stands within developed areas will be thinned to promote vigor of residual trees.

II. Fire Management

The presence of natural fire as an ecologic factor is absolutely fundamental to the perpetuation of these Parks' natural resources. The Fire Management Plan was approved and partially implemented in June 1979 with the goal of allowing natural fire to burn freely throughout these Parks. Natural fire will be allowed to shape ecosystem structure, but will not necessarily produce the ecosystem structure present when these Parks were discovered. Objectives and constraints are:

A. Continue to allow naturally occurring fires to burn unimpaired within the designated 707,000-acre Natural Fire Management Zone:

1. Naturally occurring fires within this zone are continually monitored, and suppression, confinement, and containment actions are implemented if a fire threatens to burn beyond zone boundaries, produces an unacceptable amount of smoke, or threatens safety.

2. The effects of natural fire on vegetation, fisheries, wildlife, water quality, air quality, and other ecosystem components will be documented, as needed.

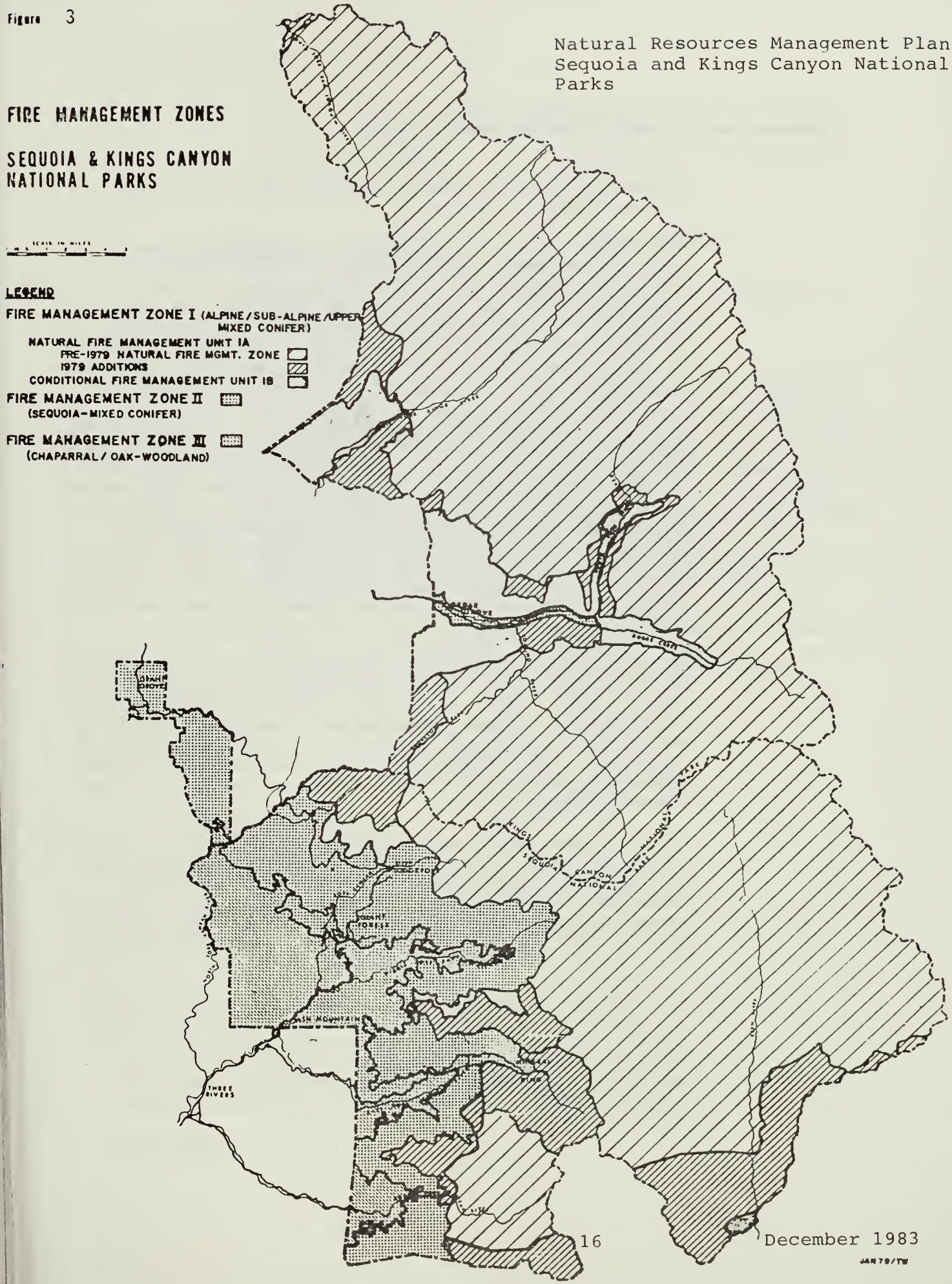
3. Since the program's goal is to allow natural processes to continue to interact in the Natural Fire Management Zone to the fullest extent possible, no strategies will be employed to lessen or enhance the results of natural fire in this Zone, unless results are incompatible with other park management objectives.

B. Prescribe burn to reduce fuel hazards in areas where fuel is unnaturally heavy and wildfire threatens park resources and human safety:

1. The purpose of prescribed burning is hazard fuel removal. Generally, a burned area will be placed in the Natural Fire Management Zone directly after one or more treatments; natural fire will be the force which shapes vegetation and fuel mosaics, succession, and other ecosystem components, approaching natural balance as closely as possible.

2. Prior to burning, a detailed prescribed burn plan for each burn will be prepared by qualified personnel and approved by the Superintendent (see Fire

Figure 3



December 1983

Management Plan, Prescribed Fire Monitoring and Prescribed Burn Guides.)

3. Burning will be done during periods when smoke will be carried away from populated areas, preferably over these Parks where it can dissipate. All required burning permits will be obtained prior to prescribed burning and all restrictions observed. No burning will be done below an inversion layer or in the absence of suitable smoke dispersal. Smoke management will be part of every prescription.

   However, smoke may also be important in perpetuating natural conditions. Since the role of smoke in the natural system is not clearly understood, the effect of fire suppression's removal of it from the system is not known. Certain species in these Parks have likely adapted to its presence and have perhaps used it to their benefit, as they have used fire. Pathogen inhibition from exposure to smoke has been reported by Parmeter and Uhrenholdt (1974). Particulates produced by fire may also perform some filtering and cleansing effect on air quality.

   An inversion occurs in the Central Valley during the fall, which will preclude the ignition of prescribed burns below 2,000 to 3,000 feet during this period of poor air movement and smoke dispersion, unless a variance is obtained from the air pollution control district. The remainder of the year tends to have unstable atmospheric conditions and therefore good smoke dispersal.

   Various drainages and steep topography also serve to disperse smoke from fires. Diurnal upcanyon winds mix and blow smoke east where it is dispersed. Smoke may settle into canyons at night, but readily moves upcanyon during the day; like air currents, smoke and urban pollution tend to flow up drainages during the day, and downcanyon at night.

4. The annual objective of the prescribed burning program will be 2,000 to 5,000 acres. This will drop as more acres of these Parks are placed in the Natural Fire Management Zone. Areas may also be added to this zone if fuel inventories and fire behavior modelling show that no unnatural fuel hazard exists.

5. The public and other land management agencies will be notified before burning, and later on progress of burning. Conduct cooperative prescribed burns when possible.

C. Continue to suppress fires not contributing to fire management objectives:

1. Suppression will be directed toward achieving control, confinement, or containment with minimum natural resource damage.

2. All wildfires of Class C or larger size (more than 10 acres) or natural fires requiring some degree of suppression or containment will be inspected by the Environmental Specialist who will identify existing and potential sources of environmental impact caused by the suppression action. Obliteration and rehabilitation of all firelines, camps, and helispots will be effected before control forces are released, if possible. In addition, cut stumps will be treated by borax, and all felled trees will be bucked to lay flat on the ground and limbed, with all slash either burned or lopped and scattered.

3. Helispots will be constructed only when other means of transportation are clearly not feasible. No helispots will be pre-constructed for possible future use.

III. Human Impact on Sequoia Groves

A. Implement development concept plans for Lodgepole-Giant Forest and Grant Grove which provide for the removal of visitor and concession facilities, except selected interpretive aids, from the sequoia groves:

Special provisions will be made for obliteration of secondary service roads, restoration of obliterated roadbeds to their natural state, and elimination of multiple footpaths.

B. Continue to restore sequoia groves to natural conditions:

This will involve the use of prescribed burning to reduce hazardous levels of fuel. Natural fire will be allowed to the fullest extent possible after the prescribed burn. Cyclic prescribed burning will be done only in heavily visited groves to mimic the effects of natural fire in areas where the presence of natural fire is incompatible with visitor safety, and in areas that are to be maintained in some specific historical ecosystem structure. Prescribed burning will also be conducted differently in groves with high aesthetic value. Specific portions, identified as "showcase areas", will be burned with minimal scorch and trunk char, and are managed more for social rather than biological purposes. These "showcase" areas are identified in the Fire Management Plan.

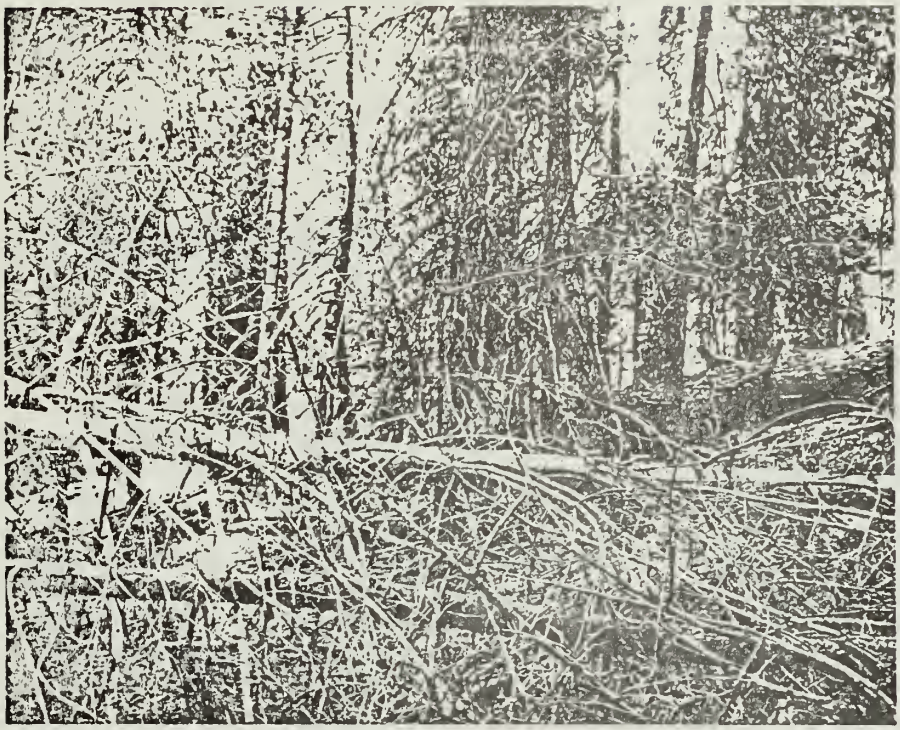


FIGURE 4 Before prescribed burning, this giant sequoia-white fir forest had been protected from fire for about 50 years. The unnatural and hazardous accumulation of litter, debris, and saplings is evident.

FIGURE 5 After prescribed burning, the area is clear of much of the debris and undergrowth. Increased light penetration to the forest floor will encourage wildflower growth, and visitors to the area can move about with ease.

IV. Wildlife Management

A. Manage native animals as naturally functioning populations and give special protection to threatened and endangered wildlife species:

1. Black Bear Management

Black bears (Ursus americanus) are an important wildlife resource widely distributed throughout these Parks, but primarily below 9,000 ft. Many of these bears live near developed or heavy use areas.

The high degree of overlap between bear habitat and areas frequented by Park visitors causes sustained problems with bears; some are serious. With development in these Parks, unnatural food became available to bears from several sources. Though some food is obtained by intentional feeding, most found is acquired because of improper food storage, overflowing garbage cans, failure to secure the latch on bearproof dumpsters, or by frightening people from their food. The availability of human food has resulted in damaged property and personal injuries.

The goal of the bear management program is to restore and perpetuate the natural distribution, ecology, and behavior of black bears free of human influences.

Management objectives are:

a. To minimize the availability of human food sources and human activities which may significantly modify bear populations.

b. To minimize unpleasant interactions between bears and people and mitigate such interactions when they occur.

c. To provide opportunities to help visitors understand and appreciate the black bear in its natural environment.

To achieve these objectives, a multi-phased program is being implemented that includes: (1) construction of bear-resistant food storage and garbage

facilities; (2) public information and education; (3) enforcement of regulations regarding feeding of wild animals and proper food storage; (4) implementation of bear handling procedures which are humane, as well as biologically sound; and (5) continuation of research and monitoring programs on the black bear population and management techniques. The Bear Management Plan provides further details.

2. Deer Management

The objective of the deer management program is to restore and perpetuate a naturally functioning mule deer Odocoileus hemionus population. Mule deer populations are subject to wide cyclic fluctuations depending upon both natural and man-caused factors. The number of deer in these Parks has varied extensively during period of record covering the last nine decades. During that time these Parks' herds went through periods of recovery following earlier indiscriminant hunting, many years of predator control, population explosions, loss of forage, increased parasite loads, deer herd reduction programs in the 1950's and 60's, and periods of becoming pests in their attempts to get food or minerals from visitors.

Current statewide reports of declining deer numbers have been of general concern, though the Kaweah deer herd may be increasing. In general, the status of deer populations in these Parks is poorly known. Fire suppression in the past years altered vegetation communities, limiting available forage and reducing deer range. The natural role of fire in developing and maintaining vegetation mosaics and availability as browse material is important in maintaining natural deer populations. Effects of fire on deer range should be examined as fire is returned to its natural role.

Park deer herds need to be monitored as to population size, migration patterns, habitat utilization and habitat condition. General reductions in the population, if required, will be carried out in cooperation with the California Department of Fish and Game outside these Parks' boundaries through special hunts or other mutually acceptable management techniques.

3. Threatened and Endangered Terrestrial Wildlife Management

The condor, (Gymnogyps californianus), peregrine falcon (Falco peregrinus), and the southern bald eagle, (Haliaetus leucocephalus leucocephalus) are the only terrestrial species classified on the Federal list of Threatened and Endangered Wildlife. All three species are listed as endangered. The condor has been extirpated from the vicinity of these Parks. The bald eagle is a rare transient. Peregrine falcons are observed most years. They are believed to be transients, but some could be resident. Peregrine falcons are known to have formerly nested in the Ash Mountain area, and a thorough evaluation of potential habitat is needed.

4. Bighorn Sheep Management

Bighorn sheep, (Ovis canadensis), occur as two separate herds within these Parks: the Mt. Baxter herd of about 180-200 sheep and the Mt. Williamson herd of about 30 sheep. These herds summer along the Sierra Crest and winter in Owens Valley. In the late 1800's, sheep ranged along most of the Sierra crest and the Great Western Divide, but they were rapidly decimated by hunting, competition with cattle and domestic sheep, and diseases acquired from domestic stock. The Mt. Williamson herd is barely sustaining itself; however, the Mt. Baxter herd has had sufficient growth to provide animals for restoration in the Mt. Langly and Wheeler Crest areas of the Sierra Crest. A Bighorn Sheep Management Plan and Environmental Assessment were completed in 1986. Sheep need to be restored to their former range on the Great Western Divide where they were once abundant if public review is favorable.

5. Vector Management

Woodrats (Neotoma fuscipes) and other rodents (brush mice, Peromyscus boylei; white-footed deer mice, Peromyscus maniculatus) enter older dwellings in residential areas where, by nest-building and related activities, they damage structures and present a health hazard with their accompanying parasitic fleas. These parasites are vectors of disease or-

ganisms which may infect man. Accumulated litter and chewed electrical insulation can be a fire hazard.

Rodents will be controlled when they are present within dwellings. Treatment of individual dwellings will be carried out primarily by use of traps (either snap-traps or live traps) and rodenticides. Rodenticides will not be used outside buildings. As funds become available, dwellings will be upgraded to a standard prohibiting access of woodrats.

Ground squirrels and other mammals may serve as a reservoir for plague, Pasteurella pestis. Fleas carry the disease from squirrels to humans. When plague is identified, areas will be posted, possibly closed, and burrows and individual animals (using self dusters) may be dusted with an approved biocide for fleas. Direct reduction of ground squirrels is permitted only within developed areas and only where there are no other alternatives to protect human health and safety. Rodenticides will not be used.

6. Management of Exotic Fauna other than Fish

The beaver (Castor canadensis) was introduced into U.S. Forest Service lands adjacent to Sequoia National Park in the late 1940's and early 1950's. In subsequent years, it extended its range into the Kern Canyon portion of the Park. Recently, the animal has had a significant impact on the area through such activities as cutting of trees and building of dams. In past years, such control techniques as shooting, blasting and burning of dams, and trapping have been attempted. Trapping was the most effective, but overall attempts have been unsuccessful because of their high fecundity and immigration from untrapped areas. Loss of acceptable habitat caused by their own dietary habitats may be exerting the major control on their numbers, though their true status has not been verified by surveys. To eliminate this exotic will require removing the entire population, not just those within these Parks' boundaries, and will require an interagency program, if done at all. If not removed, there may be permanent changes in the ecology of the Upper Kern River and adjacent riparian areas.

Feral pigs (Sus scrofa) were found near South Fork campground in Sequoia National Park in April 1982. There are known populations of feral pigs adjacent to Sequoia National Park along its west boundary. Pig habitat within these Parks will be surveyed and all pigs found within these Parks will be killed and left to decompose. No feral pigs will be killed in view of visitors. Where necessary, pigs will be trapped and moved away from the public before they are destroyed.

Brown-headed cowbirds, Molothurus ater, moved into the Sierra Nevada as people, especially their stock, moved into the mountains. Today they are common in all developed areas of these Parks. Because they are nest parasites, their presence is detrimental to native species. Several species may be in danger of local extirpation. The yellow warbler, willow flycatcher, solitary vireo, and warbling vireo are the species believed to have been effected most. Environmentally sound, economical, and humane ways are needed to control cowbird populations.

Other species of exotic mammals and birds (including english sparrow, house cat, opposum, and starling) occur in these Parks. Current distribution and status of these species are poorly known. An inventory of the distribution and ecological impact of all species of exotic birds and mammals in these Parks needs to be conducted. Plans need to be developed regarding management of these species.

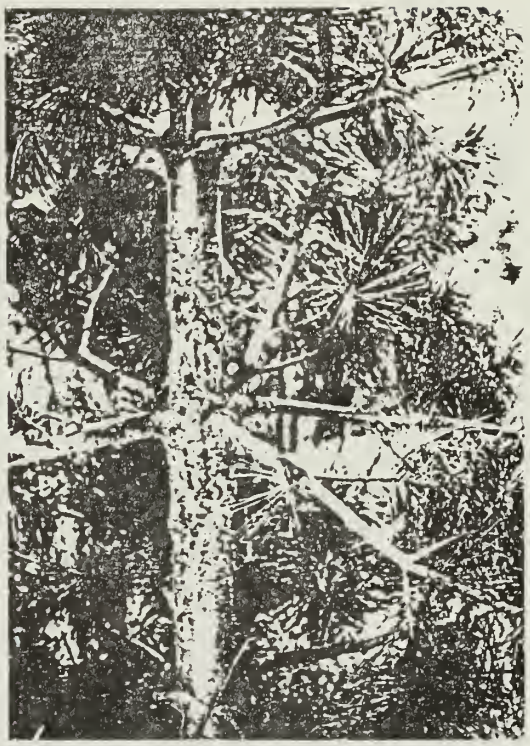
7. Marmot Management

In the Mineral King area, marmots enter automobiles and often cause damage, primarily chewed radiator hoses and electrical wires. This results in cars that are either completely inoperative or else overheat on their return from Mineral King. The cause of their behavior is unknown but a sodium deficiency is expected.

8. Clough Cave Bats

Clough Cave is a roosting site for big-eared bats (Plecotus townsendii), and it may be used as a maternity site and/or hibernaculum. The cave has

FIGURE 6. Blister rust cankers on white pine.



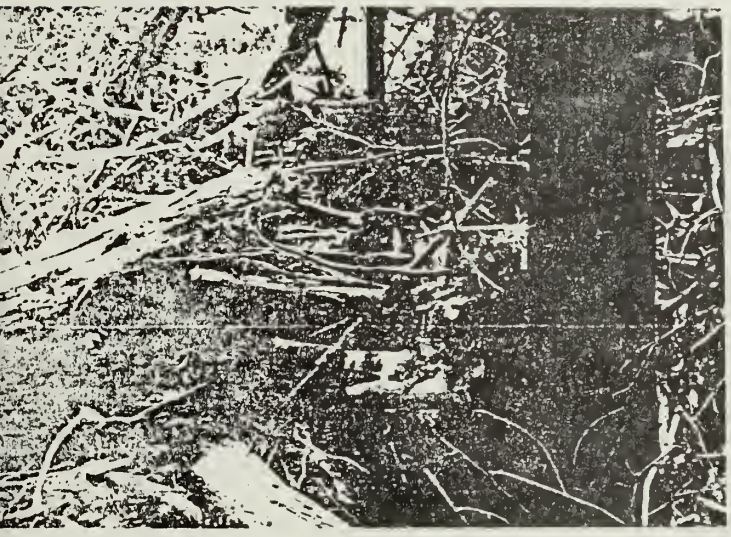


FIGURE 7 Beaver damage on the Kern River.

FIGURE 8 Hazard tree failure.

been closed to human use. Until more is known about the site and the vulnerability of the bats to human disturbance. Because weastern big-eared bats are declining, they are being considered for Federal listing.

V. Aquatic Resources Management

A. Preserve, restore, and maintain endemic species and native aquatic habitat wherever possible:

1. Fisheries Management

Stream surveys in the Kaweah River drainage during 1980 and 1985 show that alien brown trout have increased from five percent to 12 percent of the fish population at monitoring sites at the expense of native rainbow trout. The loss was greatest in low elevation sites with highest potential fishing pressure.

A cooperative study between California Department of Fish and Game and National Park Service to evaluate biological, recreational, and economic considerations involved in aquatic resources management was conducted in 1977. This study surveyed 137 high elevation lakes to survey the status of the fishery in those lakes. The survey concluded that sixty percent of the lakes would maintain a self-sustaining trout population without stocking.

A new fisheries program is being developed that will continue to provide for recreational fishing but also help restore the natural distribution and abundance of native species and reduce survival of alien species.

2. Management of Threatened Fish

The Little Kern golden trout (*Salmo aquabonita whitei*) is resident in both the Soda Springs Creek and Coyote Creek drainages. It was listed as a threatened species in 1977, and its former range in the Little Kern drainage (of which Soda Springs Creek is a part) was declared critical habitat. An interagency management plan involving California Department of Fish and Game, the U.S. Fish and Wildlife Service, the National Park Service, and the U.S. Forest Service is being implemented to restore Little Kern golden trout to their former range in the Little Kern watershed. As part of this plan, non-native rainbow trout, brook trout, and rainbow/Little Kern

golden trout hybrids are being eliminated to provide for restocking those waters with genetically pure specimens. The pure population in Coyote Creek is not natural in origin, having been planted there from the Little Kern drainage sometime near the turn of the century. Additional inventory work is needed on the distribution and population size of the Coyote Creek population; the Soda Springs Creek population will continue to be surveyed annually as long as fish are being removed for use elsewhere in the restoration program.

3. Exotic Fauna in Aquatic Systems

Two of the resident species of trout are exotic. The eastern brook trout (Salvelinus fontinalis) came from the eastern United States, and the brown trout (Salmo trutta) came from Europe. Additionally, species native to this area were planted into waters where they did not occur formerly. Originally, most of the high elevation rivers and streams were barren of fish.

At least one exotic invertebrate, an amphipod called Hyalella azteca, was deliberately introduced into certain lakes. This was apparently done to provide food for introduced fish. Management will favor native species over exotic species.

4. Kaweah Diversion

Since 1913, water has been diverted from the Marble and Middle Forks of the Kaweah River for use in generation of electricity. The diverted portion of river extends four and one-half miles upstream from Sequoia National Park boundary to the vicinity of Potwisha Campground.

This four and one-half mile stretch of the Kaweah River is one of the few protected examples of unique foothill riparian ecosystem. Studies conducted by National Park Service personnel in 1963 resulted in negotiated restrictions on water use. A minimum release established at that time is still in effect.

Following a contract evaluation of the impacts of the diversion during 1979 - 1984, Congress approved con-

Fig 9. Kaweah Diversion

tinued operation for 10 years with the option of renewing the permit twice for the same interval.

B. Analyze, classify, and monitor water quality in all Park waters and monitor selected snow courses:

1. Water Quality Monitoring

On October 18, 1972, Congress enacted Public Law 92-500: "Federal Water Pollution Control Act Amendments of 1972." On December 15, 1977, Congress amended the 1972 Act by passing Public Law 95-217: "Clean Water Act of 1977." The Law states that "Each. . . agency. . . of the Federal Government having jurisdiction over any property. . shall be subject to, and comply with all Federal, State, interstate, and local requirements..."

As an outcome of the above Laws, a Memorandum of Understanding between the Service and Environmental Protection Agency has been established. The Memorandum provides for interagency water quality management to include:

a. "Identification of ambient conditions necessary for naturally balanced populations . . . "

b. "Participate in review and revision of State water quality standards", water quality criteria, and development and implementation of water quality management plans.

c. "Participate in assessment of water quality impacts of both point and non-point sources . . ."

d. "Provide . . . technical material pertinent to NPS resource management concerns . . ."

e. Compliance with State water quality standards and to "advise EPA and the State agencies of NPS monitoring results which indicate pollution that threatens areas . . . under Service jurisdiction.

f. ". . . to recommend to EPA, State and local agencies, the specific water quality standards and criteria necessary to protect such listed (threatened or endangered) species and their natural environment."

g. Encourage exchange of information.

This requires an analysis of present park waters and a resulting classification of these waters for future uses. Such classifications should be in harmony with water classifications established by the State, acting in response to the above laws. Monitoring to insure nondegradation of established water standards is necessary. An Aquatic/Water Resources Management Plan was developed to enable these Parks to monitor and to detect changes in their water quality in major water sources, and to monitor the quality of water leaving these Parks. Data collected by the U.S. Geological Survey and these Parks' staff will be used in the Aquatic/Water Resources Management Plan. When water quality degradation is evident and the cause or ecological implications are unknown, studies will be conducted to provide that information for management recommendations.

2. Snow Surveys

These Parks are participants in the California Cooperative Snow Surveys headed by the Department of Water Resources, Resources Agency, State of California. Five snow courses are monitored within these Parks. Measurements, including average snow depths and water content, are taken from January to April by these Parks' personnel.

VI. Meadow Restoration and Grazing

A. Continue to restore ecological relationships within meadow environments that have been clearly altered by the influence of human activity:

1. Meadow Restoration

a. Streambank stabilization and sloping may be utilized to reduce erosion and sedimentation. More nearly natural gradients may be achieved by erecting a series of check dams and raising them as fill collects behind them.

b. Trails which are located in meadow vegetation will be relocated and abandoned treads stabilized and obliterated. A considerable backlog of abandoned trails in meadows exist.

c. The cover and density of meadow vegetation, and meadow surface characteristics as a whole, in popular areas have improved due to their protection from livestock grazing, particularly after 1958 when Sharsmith (1958) documented the deterioration of many meadows due to grazing. This led to the closure of several meadows to grazing.

d. Some meadows are being invaded by lodgepole pine. In the past, lodgepole pine were removed from certain meadows in an attempt to rectify the effect of human influence. In most meadows where lodgepole pine were removed, the trees reestablished themselves very quickly, due in part to unavoidable disturbance caused in the removal process. It appears that lodgepole encroachment is now proceeding primarily as a result of natural processes. While there are meadows where the lodgepole pine forest interface reflects man's past influence, this condition will be allowed to exist unless this influence is affecting radically the current rate of encroachment, or where the configuration of the meadow is such that the presence of lodgepole pine in areas of past influence radically affects adjacent but otherwise isolated portions of a meadow.

B. Implement the Stock Use and Meadow Management Plan; adjust opening dates as appropriate; and establish condition and trend plots to assess effect of grazing management program:

1. Grazing

The Plan essentially provides guidelines to control the effects of stock use on the resources of the backcountry and includes a monitoring program to evaluate impacts from stock use.

The primary components of the Plan are as follows:

a. Opening dates are set to control the effects of early season grazing use on the vegetation and soils of the sensitive meadow and associated forage areas.

b. Grazing use levels are controlled through limits on the number of stock per night and the number of nights per party that are allowed in certain forage areas. In addition some forage areas may be closed to grazing, either permanently or temporarily, as necessary to protect resources.

c. Trails and areas open to stock use are designated in the Plan as required by 36 CFR 2.16(b). Areas open to off-trail travel are designated, including the Roaring River, Hockett Plateau, Chagoopa Plateau and portions of the West Kern Plateau, and Granite Lakes and associated area. Some trails are designated for day use or pass-through, and some trails are open to stock use but will not be maintained.

d. A series of meadows are closed to grazing for scientific study and visitor enjoyment. Thirteen such meadows are designated.

e. A formal monitoring program is established that concentrates on detecting change in vegetation and soil conditions over time.

f. There is provision for modification and update of the Plan including public review of any significant changes.

g. A number of drift fences exist throughout these Parks. These fences exist to prevent overuse and deterioration of Park resources. They also incidentally serve to prevent stock from moving long distances. No fences are permitted which hold stock in small limited areas except for six administrative pastures where stock is temporarily held for use in connection with the management of these parks.

B. Eliminate Trespass Grazing in the North Fork Kaweah and Yucca Creek Drainages:

1. Trespass Grazing

Trespass grazing is a major problem in the lower part of the North Fork Kaweah and Yucca Creek drainages. To a lesser extent it occurs south of the main stem of the Kaweah River near Ash Mountain, Milk Ranch, and the Mineral King Road at Lookout Point Impacts include conversion of grass to feces, loss of sedges along parts of the rivers and creeks, trampling of wetlands, formation of cattle trails, and deposition of bovine feces in natural waters. During low water conditions, cattle freely cross the North Fork into the Park. Existing fences are not maintained as well as they should be, and more personnel are needed to provide better patrol and enforcement in the problem areas.

C. Stabilize and restore Cahoon Meadow to approximate more nearly natural conditions:

Monitoring of resource deterioration in Cahoon Meadow, including possible effects on downstream aquatic resources, will continue. Stabilization and restoration of the meadow will be conducted when funds become available.

VII. Roads, Trails, and Developed Sites

A. Stabilize and naturalize abandoned roads and trails by established soil and moisture conservation and engineering techniques to prevent the development of erosive conditions and to facilitate their return to a near natural condition:

1. Within these Parks are approximately 113 miles of surfaced roads, 63 miles of dirt roads, 35 miles of surfaced trails and 755 miles of unsurfaced trails. Part of the road system and much of the trail system were established prior to the development of construction standards. As a result, roads and trails have been designed and constructed to a variety of standards. Where trails were built before the establishment of these Parks, it is doubtful if any standards were used.

2. All abandoned roads and trails will be treated by established soil and moisture conservation and engineering techniques to prevent the development of erosive conditions and to facilitate their return to a near natural condition as rapidly as possible. Such practices include the construction of water turning devices, the loosening of compacted surfaces to facilitate natural vegetative regeneration and possible seeding with native species. Before any new trails or roads are constructed, those to be replaced and abandoned or not maintained will be treated as above. Where feasible, all abandoned non-paved roads within giant sequoia groves and the surrounding ecosystem will be rehabilitated. As physical developments are removed from giant sequoia ecosystems, access roads will be removed and returned to a near natural condition. All system trails and roads will be maintained to prevent erosion of those developments and adjacent affected areas. All trail maintenance and soil and moisture conservation personnel will be trained in approved methods and techniques for rehabilitating and obliterating trails.

3. Resources Management will perform continuing surveys of existing roads and trails to identify detrimental environmental impacts caused by the de-

sign, construction, or maintenance practices. As impacts are identified, plans will be made and implemented to eliminate the causes of the impacts and remove their effects where feasible.

4. Prior to design and construction of all roads or trails or trail relocation activities, an impact analysis will be performed by the Resources Management Division.

B. Monitor impacts of developed sites:

Several environmental assessments and one facility permit called for various types of environmental monitoring in conjunction with various park developments. This monitoring has included primarily aquatic nutrients, bacteria, soil, and forest vegetation, and it was needed primarily at sewage sprayfields and in meadows from which water was diverted. With continued plans for major developments in the Clover Creek and Grant Grove areas and the continuation of the Kaweah No. 3 water diversion, monitoring needs will continue to increase. When major developments are placed within these Parks, a program to provide a means of detecting and correcting potential adverse impacts to adjacent undeveloped parklands will be developed.

VIII. Human Use of Wilderness

A. Continue rationing visitor use at trailheads and further refine limits based on carrying capacity studies:

1. A criterion for rating impact will be established. Controls on use of such areas to return them to acceptable environmental conditions will be developed.

2. The condition of impacted areas will be monitored also. When they improve to an acceptable environmental standard, permits will be reissued on a basis which will prevent use from lowering conditions below the standard. A flexible permit system designed to retrieve use information by specific sites, and to prevent impact by controlling the number of permits issued for impacted areas will be implemented.

3. A wilderness use educational program will be instituted by which wilderness users can be exposed to a short program pointing out the ways in which visitor behavior can ameliorate resource damage. Whenever warranted, such a program will be weighted toward the problems of the area adjacent to the entry trailhead. An extension of this action would be to establish a requirement that users be exposed to such information as a condition for issuance of a wilderness permit.

4. Rationing will be imposed only as a last resort after the demand for use exceeds the ecological and/or sociological carrying capacities of an area and all other management programs such as visitor education efforts have been exhausted.

IX. Cave Management

Sequoia and Kings Canyon National Parks contain over 70 caves, including some of the largest and most spectacular in California. In Caves of California, Halliday described 21 park caves including Crystal, Clough, Lilburn, and Soldiers Caves. Each of these caves is unique and should be protected at all costs.

The complexity of the caves in these Parks as well as access to them, deterioration by visitor use, vandalism, litter, search and rescue, and other problems, makes the cave resource very difficult to manage. The primary objective for the management of caves in these Parks must consist of managing the resources of the caves to minimize any alterations of the existing biologic and geologic features.

In the past, Crystal Cave has experienced heavy visitation. In 1985, 50,772 persons visited the cave. During the summer season, guided tours are offered as part of these Parks' interpretive program. Attendant developments inside the cave include handrails, cemented walkways, and lighting. The historic management of Soldiers Cave has been oriented primarily toward visitor safety; technical climbing gear and cave experience have been required before entrance was allowed. In an effort to enforce the limited access to Crystal and Soldiers Caves, each cave has been provided with a locked gate.

To date, little attention has been given to cave management for protection of the cave resource. The fact that a cave might be irreversibly damaged by every human visit presents additional problems. The brown stains on the formations found in Soldiers Cave as well as in several other park caves were caused by the rubbing of muddy or dirty clothes against the formations. By merely touching the formation, human body oil permanently stains a speleothem, and many speleothems are extremely fragile. Human body waste causes a special problem. The waste is sensually displeasing, and it pollutes the cave environment. Vandalism is another serious problem. A speleothem that required thousands of years to form is very brittle. One careless movement or one thoughtless act disallows countless others the chance to view the formation's priceless beauty. These types of damage can be eliminated in our cave resource only with adequate protective management.

"Protection and enforcement of the rules and regulations pertaining to the preservation of natural features should, and must, be particularly strong in this Park where these features are dead and irreplaceable."

Any damage done to a formation in a cave is permanent. There is far too much evidence of such damage in the many caves in these Parks.

Clough Cave demonstrates the result of vandalism. This once beautiful cave is now no more than a hole in the ground. Almost all the breakable formations are destroyed. The flow formations and columns are mud stained. The damage is irreversible. Halliday (1962) says of Clough Cave, "Because of its ease of access, vandalism has left mere vestiges of its former beauty." Only strong protective management will help to preserve remaining cave resources.

The following actions will be taken to manage the caves in Sequoia and Kings Canyon National Parks:

1. A thorough inventory of all park caves and cave resources has been conducted to provide a basis for future management decisions. This inventory will be kept up-to-date.

2. All park caves will be classified for appropriateness for public access. Classification will be for open recreational use with no restrictions, restricted to scientific or educational study only, controlled access because of safety or hazardous conditions, and closed because of extreme hazards or fragility of pristine areas. When necessary, cave entrances will be provided with locked gates. Location of most caves will not be public information.

3. Crystal Cave will continue to be a part of the Park interpretive program. Visitors will be offered a guided tour during the summer months. The maximum group size will be 120 persons (a number estimated by Park Interpreters to be the maximum which can be adequately handled by guides without risking damage to the cave resource). An emphasis will be placed on educating the public to the importance of conserving the cave resource.

4. Lilburn Cave has been designated a research cave. Because of its use as a research area, entry is restricted to bonifide research personnel.

X. Air Quality Management

Both Parks were established largely on the basis of vistas reported by early explorers such as King (1871). These reports also formed the basis for the widely held view that frequent Indian or lightning fires kept mixed conifer forests open and fuel loads low.

The scenic resources set aside in these Parks by Congress should be managed to maximize clean air over their entirety for viewing by visitors. To appreciate the magnificent resources, they must be seen, and pollutants, on occasion, impair this view and appreciation of our natural heritage. The importance of air quality in the formation of these Parks can be seen in the following:

Letter by Franklin K. Lane, Secretary of the Interior to Senator H. I. Myers, Chairman, Committee on Public Lands, U.S. Senate, May 15, 1918.

> "Scenically this country is unexcelled, of its kind, in the United States." Commenting on S. 2021 adding certain lands to Sequoia National Park.

Minority views to accompany S. 2021 passed by Senate, January 16, 1919, to add certain lands to Sequoia National Park.

> Senator Phelan, ". . . constitutes a total supreme scenic magnificence. It would make a national park unexcelled even in America, for sublimity and unequaled anywhere for rich variety. It is penetrated by trails, and affords, with its three foaming rivers, its thousands of streams, its hundreds of lakes, its splendid forests, occasional meadows, castellated valleys, inspiring passes, and lofty glacier-shouldered summits, the future camping-out resort of many thousands yearly."

April 16, 1939, letter by Harold L. Ickes, Secretary of the Interior in letter to Hon. Rene L. DeRouen, Chairman, Committee on the Public Lands, U.S. House of Representatives.

> "The purpose of the Act (H.R. 3794) is to conserve permanently in its natural condition, as a national park for the benefit and enjoyment of the people, one of the most famous scenic areas in the United States, Kings Canyon National Park."

In an effort to evaluate the extent and effects of human-caused air pollution, these Parks have developed an air quality monitoring program with the help of the Western Region Natural Resources Management Office, the Air and Water Quality Division (AWQD) in WASO and Denver, the Environmental Protection Agency (EPA), the U.S. Forest Service (USFS), and the California Air Resources Board (CARB). The AWQD and the USFS have also conducted or funded over $115,000 of effects research in these Parks since 1982.

Specific effects research has focused on Air Quality Related Values (AQRV's) such as sequoia seedlings, black oak, and yellow pine. The AWQD also coordinated the Integral Vista Project in 1980, in which vistas important to visitor experience were documented. In the largest effects project, the air quality monitoring program is involved in the acid deposition research being conducted in Sequoia and Kings Canyon, which involves the influence of air pollution on ecosystem integrity. In short, with the aid of these organizations, the air quality monitoring program has grown rapidly.

Temporary visibility impairment from prescribed fire does not conflict with the perpetuation of the natural air quality. When natural fires did occur, with frequencies believed to be about four to 20 years in the mixed-conifer type (Van Wagtendonk, 1972; Biswell, 1972; Kilgore and Taylor, 1979), localized smoke, and therefore occasional visibility impairment, must also have been a natural part of the system as well. The removal of smoke may have had deleterious ecologic consequences, as did the removal of fire, as a result of suppression policies. For example, certain forest pathogens are inhibited by smoke (Parmeter and Uhrenholdt, 1974).

Prescribed fire smoke should not be confused with human-caused air pollution. Wood smoke rarely, if ever, contains nitrogen oxides or sulphur dioxide (Hall, 1972), and its hydrocarbons tend to be chemically saturated and unimportant to the formation of photochemical smog (Murphy, 1972). Moreover, far more hydrocarbons are produced naturally by pine forests as terpenes which give a bluish tint to the air (Cramer, 1974).

Intense wildfires can produce ten times more particulates than low intensity prescribed fires (Coleman, 1975), since they consume much more green vegetation and woody fuel.

The potential threat of wood smoke to health is from the

volume of fine particulates, which do pose health hazards to people with respiratory problems. For this reason smoke from prescribed fires will be managed to minimize impact on developed sites. Wildfire, due to its unpredictability and resistance to control, presents a much greater threat to health than does prescribed fire.

A. Collect data to establish present air quality and to locate sensitive areas and resources in these Parks:

The level within these Parks of human-caused air pollution is largely unknown, nor is the impact of this pollution on the resources of these Parks understood. Projects which quantify the impact, temporary or permanent, of air pollution and of smoke from all types of fire will begin to establish a data base from which intelligent management strategies can be formed. Monitoring stations will be set up, air quality monitored, and the true impact of smoke and air pollution on these Parks' resources established. Such stations will be positioned inconspicuously so they will not detract from visual experiences of visitors. Smoke from prescribed fires occurring within these Parks will be studied objectively, for it may be revealed that temporary impairment of visibility is more than compensated for by benefits to the system. Smoke should not be unfairly judged until the facts are in, as was the case with fire for many years until its true importance was shown.

Sequoia and Kings Canyon National Parks have been designated as Class I under the provisions of the Clean Air Act Amendments of 1977, P.L. 95-95, and will require protection if their air quality is to be maintained within State and Federal requirements. Three means will accomplish this goal:

First, these Parks will continue to prevent wildfire as much as possible, mitigating its sometimes disastrous effects on resources. Towards this end, prescribed burning must be used to reduce fuel hazards and to begin to restore fire to its natural role. It will be performed when smoke management conditions are favorable and meet prescribed conditions. Carbon monoxide and particulate monitoring will be done to protect public health. The temporary visibility impairment which results must be accepted as part of a process which will restore and perpetuate natural conditions.

Second, urban pollution production is independent of park jurisdiction, and its levels and impacts on park resources must be controlled by other agencies. Sequoia and Kings Canyon National Parks will monitor levels and effects as much as possible to aid in documenting air pollution levels and patterns, and must be involved in the planning process of new installations that could cause a deterioration of these Parks' air quality.

Third, natural fires will be allowed to burn whenever they meet management objectives. The role not only of fire but also of smoke must be allowed to continue to function as unimpaired as possible. Further study on the importance of these elements in the system as a whole will also be performed.

Ozone is already known to be causing injury to these Parks' yellow pine species (Vogler, 1979; Warner, 1980, Williams et al., 1977). Ponderosa and Jeffrey pines are particularly sensitive to ozone and serve as indicator species. Monitoring is necessary to assist us to understand the extent of the problem. The effect of ozone on giant sequoia in particular and on vegetation in general, must be determined to protect the wilderness character of these Parks. Scientifically rigorous cause and effect correlations must be performed to establish the sensitivity to ozone of at least key species. Field plots and fumigation experiments are a part of this work. Acid deposition also needs to be studied. Its influence on park ecosystems is not known, but may have a deleterious impact on them. Pictographs are an important link to the past and should not be allowed to fade because of acid deposition.

The following specific actions will be implemented:

a. Establish year-round monitoring stations to record changes in urban pollutants and urban-caused and natural visibility impairments (e.g. terpenes from pine forests, fog, valley dust and smoke, nitrates, sulfates, and the influence of various meteorological conditions on their dispersal). A limiting factor of the present air quality monitoring program is the lack of year-round personnel to operate monitoring equipment to the required standard for data collection.

b. Monitor the impact of all types of fire on these stations, especially particulate levels and visibility.

c. Locate major natural trajectories of smoke dispersal from natural and prescribed fires for various times of the year as well as the sensitive targets (roads, campgrounds, towns, etc.) along them.

d. Study the effect of urban pollutants and smoke from all types of fire on the natural resources, particularly in the giant sequoia and mixed conifer types. The natural role of smoke in the system should be established.

e. Establish maximum acceptable levels of pollutants for sensitive targets and for selected natural resources, and compare with legal standards.

f. Monitor the impact of ozone on coniferous and deciduous species, and determine the sensitivity to ozone of as many species as possible.

g. Operate wet fall-dry fall acid deposition monitoring stations. Research will continue with the study documenting the effects of acid deposition on park ecosystems.

h. Conduct quality assurance audits to ensure that the data collected are useful to the various regulatory agencies charged with protecting this Class I area.

i. Seek funds for expanding the monitoring program to a year round function, and develop programs to carry on the air quality research projects after their termination; plots established by research must be used as permanent monitoring sites to follow future trends in air pollution effects.

XI. Research

A. Initiate or complete the research studies and inventories summarized below:

1. A comprehensive, long term research program is under way to study the effects of air pollution and acid deposition on aquatic and terrestrial communities. This program includes monitoring of input levels (both wet and dry) as well as potential ecosystem effects for selected study sites across an elevation gradient. The study is a cooperative venture with other state and federal agencies as well as University scientists. A long term commitment to continue these baseline studies is needed.

2. A computerized system for storage and retrieval of basic information on plant, animal, aquatic, and geological resources of these Parks is being developed. The field research necessary to fill needed data holes is being carried out. Permanent study plots will be established for the long term monitoring of selected natural communities. This project should eventually provide a vegetation mapas well as baseline inventories of key park resources.

3. Continuing or expanded studies of chaparral, grassland, sequoia mixed-conifer, and subalpine forest fire ecology and history are proposed. These studies, which will include historical, ecological and modeling investigations, will be designed to assist park managers in restoring natural fire regimes. Emphasis will be given to fire ecology of the giant sequoia groves.

4. Wildlife studies are underway or proposed on: black bear ecology; rare, endangered, and threatened mammals and birds, the effects of fire on wildlife, and the ecological roles of extirpated species, including the reintroduction of bighorn sheep into the Mineral King area. Inventories of small mammals, birds, reptiles, amphibians, and invertebrates are also projected.

5. Vegetation studies will be completed or initiated on: a gradient analysis of forest vegetation, the role of lodgepole pine encroachment in mountain

meadows, and endangered, threatened and exotic plants. Basic descriptive inventories of most of the Parks' plant communities are also needed.

6. Proposed research regarding human use includes refinement of criteria to evaluate human impact on wilderness environments and techniques for evaluating and rehabilitating backcountry impact.

7. Additional research needs include an inventory of lakes and streams, soil-type mapping, geologic maps an evaluation of cave resources, and sociological studies of park visitors.

8. Research has begun to document the effects of ozone on yellow pines, black oaks, and giant sequoia. Further research is needed to correlate levels of air pollution with effects on the air quality related values of these Parks.

9. Knowledge of the effects human activities have had on natural communities and basic ecosystem function is essential to enlightened management. Studies addressing descriptions of different park ecosystems are needed.

10. Independent research projects that will further knowledge of park resources will be encouraged as long as they do not result in unacceptable damage to the natural resources. Approval must be given in writing by the Superintendent for such studies.

11. Collecting of natural resource materials will be allowed under permit from the Superintendent when the collections are determined to be necessary for the acquisition of basic natural resources data, are in direct support of the goals and objectives of the Natural Resources Management Plan, and do not create unacceptable environmental impacts.

RELATIONSHIP OF THIS PLAN TO OTHER PLANS AND PROJECTS

The 1971 Master Plan provides information concerning the purpose of the two parks, their resource values, their relationship to the surrounding region, objectives of management, land classification, concepts of visitor use and interpretation, and an overall plan for their management and development. A Statement for Management, which is part of the Master Plan, was approved on July 27, 1976, and contains management objectives and planning constraints.

Action Plans describe in detail how concepts in the Master Plan are to be accomplished. In addition to the Resources Management Plan, other Action Plans include:

1. A Wilderness Proposal for Sequoia and Kings Canyon National Parks was submitted to Congress in 1983. The California Wilderness Act of 1984 designated 734,100 acres of wilderness in these Parks.

2. A plan for the Management of Backcountry Use was approved on April 27, 1976. A revised Backcountry Management Plan was implemented in 1986.

3. A Fire Management Plan was approved on June 29, 1979, and will be revised annually.

4. Vegetation Management and Wildlife Management Plans will be completed in 1987.

5. A Bear Management Plan was approved in February, 1979, and will be revised annually.

6. A Bighorn Sheep Management Plan was approved on August 11, 1986, and will be revised annually.

7. An Aquatic/Water Resources Management Plan was approved on April 27, 1984, and will be revised annually.

8. A Stock Use and Meadow Management Plan was approved March 5, 1986, and will be revised as needed.

9. The broad Interpretive Prospectus for these Parks was approved July, 1971, as was the specific interpretive plan for Lodgepole. Specific interpretive plans for other areas of these Parks have yet to be prepared.

10. Development Concept Plans concentrate on developed areas, showing circulation, allocation of space, and utilities networks. They include descriptions of proposed developments, their function and scope, and their relation to the site. The Development Concept Plan for Cedar Grove was approved July 20, 1976.

11. A Land Protection Plan for Mineral King was approved in 1984.

12. A Land Protection Plan for Wilsonia was approved in 1986.

Together, these various plans will provide a detailed description of the management and design directions to be pursued. They are, in turn, translated into legislative, public use, management, and construction programs.

To date, the Wilderness Proposal, Development Concept Plan for Cedar Grove, Draft DCP for Giant Forest-Lodgepole, Draft EIS for Grant Grove, Backcountry Management, and Stock Use and Meadow Management Plans have borne the scrutiny of public review. The recommendation to remove facilities from sequoia groves, which is part of the Natural Resources Management Plan, and is integral to the Giant Forest-Lodgepole DCP, received favorable comments from the public.

A Comprehensive Management Plan for Mineral King was approved in 1980. Management of the deer herds and fisheries of Mineral King are part of the continuing management program and both sensitive issues.

Since private land and lands administered by either the U.S. Forest Service or Bureau of Land Management border these Parks on all sides, their management objectives and land use significantly influence effectiveness of proposed actions within these Parks. An ongoing dialogue with neighbors continues as the Superintendent plans additional management programs.

Sequoia and Sierra National Forests have jointly proposed the Monarch Wilderness Area for designation under the Wilderness Act of 1964. This area was designated as wilderness in the California Wilderness Act of 1984. As the proposed area abuts the proposed park wilderness area near Tehipite Valley, its inclusion in the wilderness system will increase the total amount of uninterrupted wilderness available to the public.

The proposed Land and Resource Management Plans for the Inyo, Sequoia, and Sierra National Forests are being reviewed. Management of adjacent wilderness areas that border the Parks identified in the Plans should be consistent with management of wilderness in the Parks.

The Mono Plan, an interagency plan for cooperative management of the east side of the Sierra, is presently being developed. A portion of this document will assist in the administration of backcountry management proposals and cooperative protection of California bighorn sheep in both their summer range within these Parks and winter range in the Inyo National Forest.

The Bureau of Land Management has drafted management objectives for the Kaweah Planning Unit covering BLM administrated lands bordering southern and western portions of Sequoia National Park. While the Kaweah deer herd finds most of its summer habitat within these Parks, it has been estimated that as much as one-third of the herd uses adjoining BLM lands for winter range.

These Parks have expressed their desire to cooperate in the mutual protection of the Kaweah herd and its habitat. Depletion of the winter range by excessive cattle grazing on BLM leased land could detrimentally affect the herd.

The North Kings Deer Herd Advisory Council is an interagency body of wildlife managers concerned with the study and protection of cyclic deer populations. Representatives of these Parks participate in the activities of this Council as needed. Any significant findings will be incorporated into the Natural Resources Management Plan.

A mutual aid fire suppression agreement exists between the National Park Service, U.S. Forest Service, Bureau of Land Management, and California Department of Forestry. It provides for cooperative response to fires occurring near the boundaries of Sequoia and Kings Canyon National Parks. The fire management actions proposed do not affect this agreement.

It is important that this proposal retain its flexibility so that as programs and land uses for surrounding areas are developed and implemented, resource management within these Parks can determine and mitigate any impact on adjoining park ecosystems.

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